

Collins TE-216 4800/3600/2400 bps Wireline Data Modems Interface Specification



E.I.A. Standard RS-232B

CCITT Recommendation
V.24

MIL—Standard—188B



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I. General Description

Collins TE-216 Data Modems are designed for the transmission of digital data over voice frequency bandwidth telephone circuits at the data rates of 4800, 3600 or 2400 bits per second. The modems are available in three basic configurations: TE-216A-4D-4800, TE-216A-3D-3600, and TE-216A-2D-2400.

TE-216A-4D-4800 Data Modem This modem is equipped with four data tones and provides a transmission rate of 4800 BPS. The modem is designed to operate over a voice frequency telephone circuit that meets the specifications Type 3005 (Schedule 4, Type 4C) defined in Tariff F.C.C. No. 260. The characteristics of the Type 4C telephone circuit are presented in Table 1.

TE-216A-3D-3600 Data Modem This modem is equipped with three data tones and provides a transmission rate of 3600 BPS. The modem is designed to operate over a voice frequency telephone circuit that meets the specifications Type 3004 (Schedule 4, Type 4B) defined in Tariff F.C.C. No. 260, or the specifications of CCITT Recommendation M89 (GPO Tariff S). The characteristics of the Type 4B and the CCITT Recommendation M89 telephone circuit are presented in Table 1.

The chassis of the TE-216A-3D-3600 modem is wired identically to the TE-216A-4D-4800 modem. Conversion to the TE-216A-4D-4800 modem for 4800 BPS transmission rate is accomplished by the addition of plug-in circuit modules.

TE-216A-2D-2400 Data Modem This modem is equipped with two data tones and operates at a transmission rate of 2400 BPS. The modem is designed to operate over a voice

frequency telephone circuit that meets the specifications Type 3004 (Schedule 4, Type 4B) defined in Tariff F.C.C. No. 260, or the specifications of CCITT Recommendation M89 (GPO Tariff S).

The chassis of the TE-216A-2D-2400 modem is wired identically to the TE-216A-3D-3600 and TE-216A-4D-4800 modems. Conversion of the TE-216A-2D-2400 modem from the 2400 BPS transmission rate to 3600 or 4800 BPS is accomplished by the addition of plug-in circuit modules.

The TE-216 modems are available with customer-selected equipment options which add operational features to the modem and provide flexibility for its application to a wide range of data communication system requirements. The equipment options are applicable to each of the three modem configurations. Each modem chassis is wired to accept all equipment options. The equipment options are incorporated in the modem by the addition of plug-in circuit modules.

The TE-216 modems provide full-duplex transmission (simultaneous transmit and receive operation) over a four-wire telephone circuit. The transmit function of the modem accepts serial digital data from an external data source device, phase-amplitude modulates the data on the data tones, and applies the data tones to the telephone circuit. The modem receive function establishes synchronism with the pulse repetition rate of the signal received from a transmitting modem, demodulates and regenerates the data, and provides the data in

Table 1. Voice Frequency Telephone Circuit Characteristics For TE-216 Modems.

	<i>Tariff FCC No. 260 Type 3005 (Schedule 4, Type 4C)</i>	<i>Tariff FCC No. 260 Type 3004 (Schedule 4, Type 4B)</i>	<i>CCITT Recommendation M 89 (GPO Tariff S)</i>
Type of Service	Two Point	Two Point or Multipoint	Two Point
Attenuation Characteristics	Between 500 and 3000 Hz: -2 to +3 DB Between 300 and 3200 Hz: -2 to +6 DB	Between 500 and 2800 Hz: -1 to +3 DB Between 300 and 3000 Hz: -2 to +6 DB	Between 500 and 2800 Hz: -1 to +3 DB Between 300 and 3000 Hz: -2 to +6 DB
Delay Characteristics: Envelope delay distortion shall not exceed	Between 1000 and 2600 Hz: A maximum difference of 0.3 milliseconds Between 800 and 2800 Hz: A maximum difference of 0.5 milliseconds Between 600 and 3000 Hz: A maximum difference of 1.5 milliseconds Between 500 and 3000 Hz: A maximum difference of 3.0 milliseconds	Between 1000 and 2600 Hz: A maximum difference of 0.5 milliseconds Between 600 and 2600 Hz: A maximum difference of 1.5 milliseconds Between 500 and 2800 Hz: A maximum difference of 3.0 milliseconds	Between 1000 and 2600 Hz: A maximum difference of 0.5 milliseconds Between 600 and 2600 Hz: A maximum difference of 1.5 milliseconds Between 500 and 2800 Hz: A maximum difference of 3.0 milliseconds

serial form to the associated input/output equipment.

The TE-216 modems employ synchronous Kineplex® Signal Detection Techniques which provides optimum signal-to-noise performance.*

The TE-216 modems are designed with solid state circuits with integrated circuits employed in all digital circuits to assure high reliability. The modem is designed for continuous, unattended operation.

Equipment Options

The following customer-optional features and capabilities are available with the TE-216A-4D-4800, TE-216A-3D-3600 and TE-216A-2D-2400 modems: Data Rate Options, DC Input/Output Interface Options, Synchronization Time Options, Data Rate Timing Options, and Timing Oscillator Options.

Data Rate Options

Fixed Data Rate Option This option provides the modem with a single fixed transmission rate. The fixed transmission rate for each TE-216 modem configuration is as follows: TE-216A-4D-4800, 4800 BPS; TE-216A-3D-3600, 3600 BPS; and TE-216A-2D-2400, 2400 BPS.

Variable Data Rate Option This option provides the modem with selectable data transmission rates. The data rate mode selection is accomplished by externally applied DC level control signals. The selectable data rates provided for each TE-216 modem configuration is as follows: TE-216A-4D-4800, 4800 BPS and 2400 BPS; TE-216A-3D-3600, 3600 BPS and 2400 BPS; TE-216A-2D-2400, 2400 BPS and 1200 BPS.

DC Input/Output Interface Options

E.I.A. Standard RS-232B Interface Option The modem equipped with this option provides all data, timing, control and grounding interface circuits between the input/output device and the modem, with characteristics and functions in accordance with the specifications of E.I.A. Standard RS-232B. The electrical characteristics and functions for each interface connecting lead are described under II Electrical Characteristics.

CCITT Recommendation V.24 Interface Option This option provides the modem with data, timing, control and grounding interface circuits between the input/output device and the modem, identical with those provided with the RS-232B interface option, and in accord with CCITT Recommendation V.24.

MIL-Std-188B Interface Option The modem equipped with this option provides data and timing interface circuits between the input/output device and the modem, with electrical characteristics in accordance with MIL-STD-188B specification.

Synchronization Time Options

Normal Synchronization Time Option The modem opera-

tion is synchronous whereby the receive function of the modem is required to establish synchronism with the pulse repetition timing rate of the transmitted signal received from the telephone communication circuit. A maximum time of three seconds following the presence of received carrier at the input to the modem is required to establish synchronism.

Fast Synchronization Time Option This option provides the modem with the capability to establish synchronism in a maximum time of 50 milliseconds. This option minimizes the time required for the modem to re-synchronize to a new received signal. A "NEW SYNC" pulse with a positive duration of one millisecond, applied to the modem from the associated data input/output device, is required to quench the synchronization circuitry. Synchronism is established within 50 milliseconds following application of the NEW SYNC pulse and presence of received carrier at the input to the modem. When equipped with the Fast Synchronization Time Option, the modem also requires the control functions of the RS-232B Interface.

Data Rate Timing Options

Internal Data Rate Timing Option The modem operation is synchronous which requires the input data rate be synchronous with the modem timing rate. The modem equipped with the internal data rate timing option provides a square wave timing signal to the associated input/output device for timing the input data to the modem.

External Data Rate Timing Option The modem equipped with this option accepts a timing signal at the input data rate from the associated input/output device by means of a strapping option.

Timing Oscillator Options

Normal Stability Timing Oscillator Option When so equipped, the normal stability timing oscillator provides a signal of one part in 10^4 per day for application to the modem time base from which all timing signals are derived.

High Stability Timing Oscillator Option The high stability timing oscillator has a stability of 1 part in 10^8 per day. This oscillator is substituted for the normal stability oscillator for special applications of the modem where the high stability timing is required. A receive synchronization circuitry squelch function is provided with this option.

The receive synchronization squelch function disables the receiver timing synchronization function in the event of high noise or interruptions on the telephone circuit. During the time the receiver timing synchronization is disabled, synchronization of the modem is maintained by the inherent stability of the timing oscillators at both send and receive locations.

External Timing Oscillator Input Option This option provides for the acceptance of an external timing oscillator

*For a detailed analysis of Kineplex techniques, refer to the brochure, "Collins High Speed Data Transmission System, Kineplex."

to -10 DBM. Composite Receive Signal Input: Accepts +5 to -30 DBM.

Impedance: 600 ohms $\pm$ 10 per cent, 300 to 3200 CPS.

Voice Frequency Bandwidth Telephone Circuit Requirements The modem is designed to operate on a telephone circuit that meets the specifications defined in Tariff F.C.C. No. 260 or CCITT Recommendation M89. The characteristics of the circuits are presented in Table 1. The modem will tolerate a frequency translation error on the telephone circuit of $\pm$ 10 CPS with performance degradation of no greater than 3 DB.

TE-216A-4D-4800	Circuit Specification
4800 BPS Data Rate Mode	Type 3005 (Schedule 4, Type 4C)
2400 BPS Data Rate Mode	Type 3004 (Schedule 4, Type 4B) or CCITT M89
TE-216A-3D-3600	
3600 BPS Data Rate Mode	Type 3004 (Schedule 4, Type 4B) or CCITT M89
2400 BPS Data Rate Mode	Type 3004 (Schedule 4, Type 4B) or CCITT M89
TE-216A-2D-2400	
2400 BPS Data Rate Mode	Type 3004 (Schedule 4, Type 4B) or CCITT M89
1200 BPS Data Rate Mode	Type 3004 (Schedule 4, Type 4B) or CCITT M89

Connections Audio connections between modem and the telephone circuit are made through Connector J1. Refer to Figure 2 and Tables 2 through 5 for specific connector pin assignment information.

Data, Timing and Control Interface Characteristics

The data, timing and control signal interface circuits are provided in accordance with either E.I.A. Standard RS-232B Specification, CCITT Recommendation V.24, or MIL-STD-188B Specification.

E.I.A. Standard RS-232B Interface

All voltages and impedances on DC interface circuits meet the E.I.A. Standard RS-232B Interface Specification. The connections between a TE-216 modem and the data input/output equipment are established by means of a 25-pin connector designated J2. This connector is shown in Figure 1. A detailed diagram showing the interface circuits between the data input/output equipment and the modem is presented in Figure 2.

The nomenclature used in this document for defining certain interface functions for the TE-216 modem differs from that of RS-232B Specification nomenclature. These differences are presented in Table 6.

E.I.A. Standard RS-232B interface circuit descriptions follow:

Ground Circuits:

Circuit AA—Frame Ground

This conductor is electrically bonded to the data modem frame.

Circuit AB — Signal Ground

This conductor establishes the common ground reference potential for all interchange circuits.

Data Signals:

Circuit BA — Send Data

The input data signal on this circuit is generated by the data input/output equipment and is connected to the modem for transmission over the communication channel.

Data Levels: MARK (1) -3v to -20v; SPACE (0) +3v to +20v.

Input Impedance: Greater than 3000 ohms. Shunt capacity to signal ground including 50 feet of cable shall not exceed 2500 picofarads.

Circuit BB — Received Data

The data output signal on this circuit is generated by the receiving TE-216 in response to data signals received from the remote TE-216 Data Modem.

Data Levels: MARK (1) -6v $\pm$ 1v; SPACE (0) +6v $\pm$ 1v.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

Control Signals

Circuit CA-Request to Send

Signals on this circuit are generated by the data input/output equipment to condition the TE-216 to transmit. Data tones will be transmitted during the ON condition of Circuit CA.

The TE-216 transmits all data on Circuit BA (Send Data), while the ON condition is maintained on Circuit CA, Circuit CB (Clear to Send), and Circuit CC (Data Set Ready).

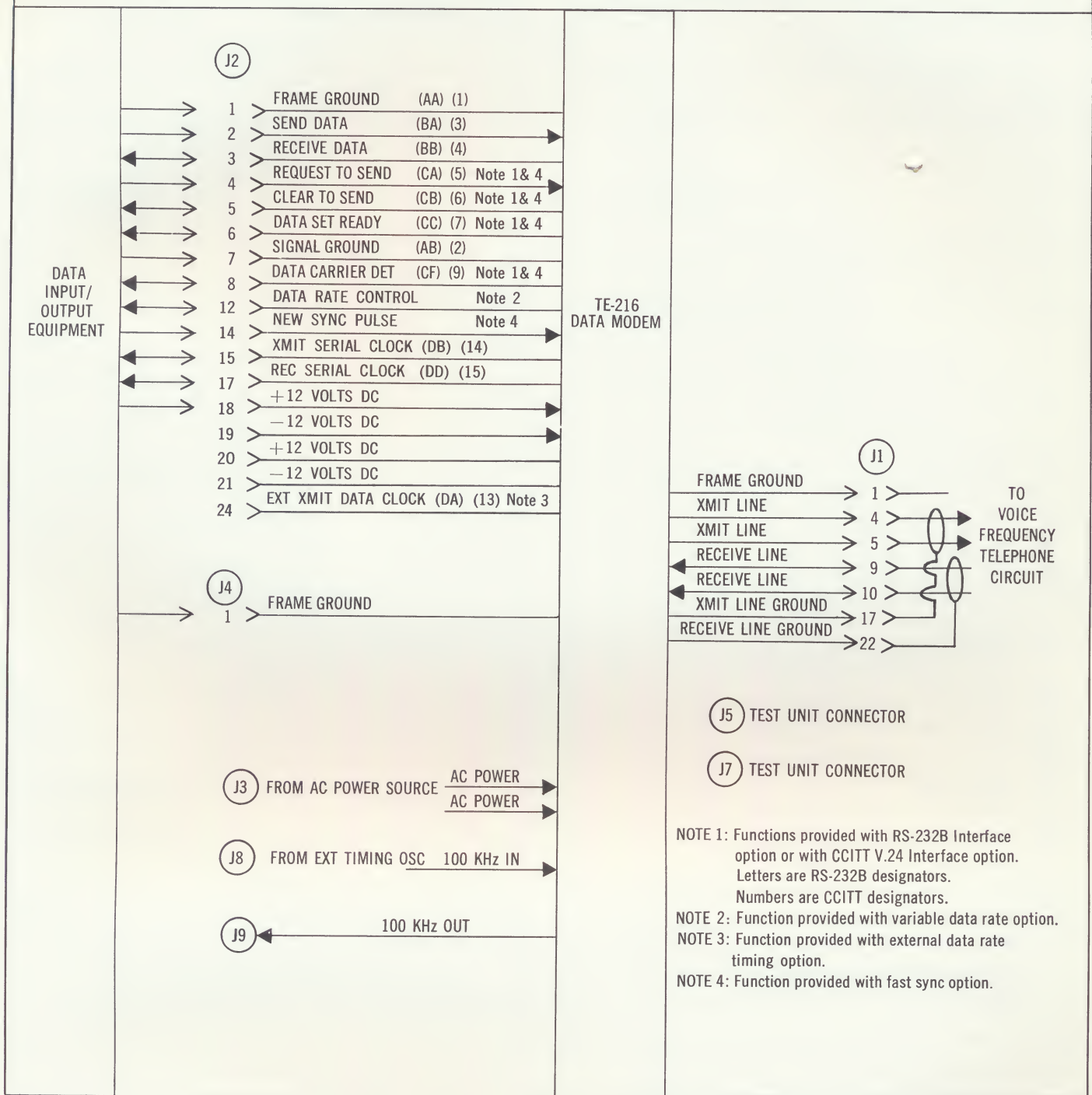
Data input/output equipment designed for either Transmit-Only or Full-Duplex service may hold Circuit CA in the ON condition at all times. Similarly, the data modem may be arranged to be in Send condition at all times, regardless of the signal condition on Circuit CA.

Signal Levels: ON Condition: +6v $\pm$ 1v. Transmission of data occurs as long as this line is held in the ON condition.

OFF Condition: -6v $\pm$ 1v. Termination of transmission occurs when this line is returned to the OFF condition.

Input Impedance: The load presented to the data input/output equipment is 3000 ohms minimum. Shunt ca-

Figure 2. TE-216 Modem Interface Connections.



capacity to signal ground including 50 feet of cable shall not exceed 2500 picofarads.

Circuit CB — Clear to Send

Signals on this circuit are generated by the transmitting data modem to indicate that it is prepared to send data. The ON condition is a response to the ON condition on Circuit CA (Request to Send), delayed as required by the modem for establishing a communication channel to a remote data input/output equipment. When Circuit CA is turned OFF, Circuit CB is also turned OFF.

In Transmit-Only or Full-Duplex service, if the data modem is arranged to be in Send condition at all times, then Circuit CB shall be held in the ON condition at all times.

Signal Levels: ON condition: $+6v \pm 1v$. This level will appear on this circuit three seconds after the Request to Send line is placed in the ON condition when equipped with the normal synchronization time option. When equipped with the fast synchronization time option, this level will appear in the ON condition 50 milliseconds after the Request to Send line is placed in the ON con-

Table 2. Input/Output Connector Pin Assignments for the TE-216 Modem Equipped with RS-232B or CCITT V.24 Interface Option and Fixed Data Rate Option.

Pin No.	Connector J1 (Audio)	Connector J2 (Data/Clock/ Control)	Connector J4***
1	Frame Ground	Frame Ground (AA) * (1) **	Frame Ground
2	-----	Send Data (BA) (3)	
3	-----	Received Data (BB) (4)	
4	Xmit Line	Request to Send (CA) (5)	
5	Xmit Line	Clear to Send (CB) (6)	
6	-----	Data Set Ready (CC) (7)	
7	-----	Signal Ground (AB) (2)	
8	-----	Data Carrier Detector (CF) (9)	
9	Receive Line	-----	
10	Receive Line	-----	
11	-----	-----	
12	-----	-----	
13	-----	-----	
14	-----	New Sync Pulse	
15	-----	Xmit Serial Clock (DB) (14)	
16	-----	-----	
17	Xmit Line Ground	Receive Serial Clock (DD) (15)	
18	-----	+12 VDC	
19	-----	-12 VDC	
20	-----	+12 VDC	
21	-----	-12 VDC	
22	Receive Line Ground	-----	
23	-----	-----	
24	-----	Ext Xmit Data Clock (DA) (13)	
25	-----	-----	

*Letters indicate RS-232B designation.

**Numbers indicate CCITT V.24 designation.

***Unassigned.

Table 3. Input/Output Connector Pin Assignments for the TE-216 Modem Equipped with RS-232B or CCITT V.24 Interface Option and Variable Data Rate Option.

Pin No.	Connector J1 (Audio)	Connector J2 (Data/Clock/ Control)	Connector J4***
1	Frame Ground	Frame Ground (AA) * (1) **	Frame Ground
2	-----	Send Data (BA) (3)	
3	-----	Received Data (BB) (4)	
4	Xmit Line	Request to Send (CA) (5)	
5	Xmit Line	Clear to Send (CB) (6)	
6	-----	Data Set Ready (CC) (7)	
7	-----	Signal Ground (AB) (2)	
8	-----	Data Carrier Detector (CF) (9)	
9	Receive Line	-----	
10	Receive Line	-----	
11	-----	-----	
12	-----	Data Rate Control	
13	-----	-----	
14	-----	New Sync Pulse	
15	-----	Xmit Serial Clock (DB) (14)	
16	-----	-----	
17	Xmit Line Ground	Receive Serial Clock (DD) (15)	
18	-----	+12 VDC	
19	-----	-12 VDC	
20	-----	+12 VDC	
21	-----	-12 VDC	
22	Receive Link Ground	-----	
23	-----	-----	
24	-----	Ext Xmit Data Clock (DA) (13)	
25	-----	-----	

*Letters indicate RS-232B designation.

**Numbers indicate CCITT V.24 designation.

***Unassigned.

dition. This level remains ON as long as the Request to Send line is held ON.

OFF Condition: $-6v \pm 1v$. This level will appear on this circuit as long as the Request to Send line is in the OFF condition, indicating the modem is activated but not transmitting data.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

Circuit CC — Data Set Ready

The ON condition for this circuit is generated by the local modem to indicate that the modem is ready to

operate. The ON condition does not indicate that a communication circuit has been established to the remote station.

Signal Levels: ON condition: $+6v \pm 1v$; OFF condition: $0v$. The OFF condition is only used to indicate that the AC power is off or the modem is not connected to the communication circuit. The ON condition appears at all other times.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

Circuit CF — Data Carrier Detector

Table 4. Input/Output Connector Pin Assignments for the TE-216 Modem Equipped with the MIL-STD-188B Interface Option and Fixed Data Rate Option.

Pin No.	Connector J1 (Audio)	Connector J2 (Data/Clock/ Control)	Connector J4*
1	Frame Ground	Frame Ground	Frame Ground
2	-----	Send Data	
3	-----	Received Data	
4	Xmit Line	-----	
5	Xmit Line	-----	
6	-----	-----	
7	-----	Signal Ground	
8	-----	-----	
9	Receive Line	-----	
10	Receive Line	-----	
11	-----	-----	
12	-----	-----	
13	-----	-----	
14	-----	New Sync Pulse	
15	-----	Xmit Serial Clock	
16	-----	-----	
17	Xmit Line Ground	Receive Serial Clock	
18	-----	+12 VDC	
19	-----	-12 VDC	
20	-----	+12 VDC	
21	-----	-12 VDC	
22	Receive Line Ground	-----	
23	-----	-----	
24	-----	Ext Xmit Data Clock	
25	-----	-----	

*Unassigned.

Table 5. Input/Output Connector Pin Assignments for the TE-216 Modem Equipped with MIL-STD-188B Interface Option and Variable Data Rate Option.

Pin No.	Connector J1 (Audio)	Connector J2 (Data/Clock/ Control)	Connector J4*
1	Frame Ground	Frame Ground	Frame Ground
2	-----	Send Data	
3	-----	Received Data	
4	Xmit Line	-----	
5	Xmit Line	-----	
6	-----	-----	
7	-----	Signal Ground	
8	-----	-----	
9	Receive Line	-----	
10	Receive Line	-----	
11	-----	-----	
12	-----	Data Rate Control	
13	-----	-----	
14	-----	New Sync Pulse	
15	-----	Xmit Serial Clock	
16	-----	-----	
17	Xmit Line Ground	Receive Serial Clock	
18	-----	+12 VDC	
19	-----	-12 VDC	
20	-----	+12 VDC	
21	-----	-12 VDC	
22	Receive Line Ground	-----	
23	-----	-----	
24	-----	Ext Xmit Data Clock	
25	-----	-----	

*Unassigned.

The modem provides an ON condition on this circuit to indicate that the data carrier is being received. When the data carrier is not present from the communication input circuit, the OFF condition is present.

Signal Levels: ON condition: $+6\text{v} \pm 1\text{v}$. OFF condition: $-6\text{v} \pm 1\text{v}$.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

Timing Signals:

Circuit DA — External Transmit Data Clock

The signal to the modem on this line is used to provide the modern transmitter with data rate timing information from the external data input/output equipment. The data level must be present at least 20 microseconds before and 20 microseconds after the negative going transition of the external transmit clock.

Signal Levels: Bipolar Square Wave $\pm 6\text{v} \pm 1\text{v}$.

Frequency:

For a data rate of 4800 BPS: $4800\text{ Hz} \pm .03\%$
 For a data rate of 3600 BPS: $3600\text{ Hz} \pm .03\%$
 For a data rate of 2400 BPS: $2400\text{ Hz} \pm .03\%$
 For a data rate of 1200 BPS: $1200\text{ Hz} \pm .03\%$

Symmetry: At all data rates $50\% \pm 1.5\%$ duty cycle.

Impedance: The load presented to data input/output equipment is 3000 ohms minimum. Shunt capacity to signal ground including 50 feet of cable shall not exceed 2500 picofarads.

Circuit DB — Transmit Serial Clock

The signal on this line is from the modem and is used to provide transmit timing information to the data input/output equipment.

The data equipment shall provide a data signal on circuit BA (transmitted data) with the data level present at least 20 microseconds before and 20 microseconds after the negative going transition of Circuit DB trans-

Table 6. Comparison of E.I.A. Standard RS-232B, CCITT V.24 and TE-216 Nomenclature.

<i>RS-232B and CCITT V.24 Standard Nomenclature</i>	<i>TE-216 Modem Comparable Nomenclature</i>
Protective Ground (AA) (1)	Frame Ground (AA) (1)
Transmitter Data (BA) (3)	Send Data (BA) (3)
Transmitter Signal Element Timing (DB) (14) (Data Communication Equipment Source)	Xmit Serial Clock (DB) (Data Modem Source) (14)
Receiver Signal Element Timing (DD) (15)	Receive Serial Clock (DD) (15)
Transmitter Signal Element Timing (DA) (13) Data Processing Terminal Equipment Source)	Ext Xmit Data Clock (DA) (13) (Input/Output Data Equipment Source)

mit Serial Clock.

Signal Levels: Bipolar Square Wave $\pm 6v \pm 1v$.

Frequency:

For a data rate of 4800 BPS: 4800 Hz

For a data rate of 3600 BPS: 3600 Hz

For a data rate of 2400 BPS: 2400 Hz

For a data rate of 1200 BPS: 1200 Hz

Symmetry: At all data rates 50% $\pm$ 1.5% duty cycle.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

Circuit DD — Receive Serial Clock

The signal on this line is from the modem and is used to provide receive timing information to the data input/output equipment. The modem provides data on Circuit BB (receive data). The data signal level will be present for a period between 20 microseconds after the positive going transition of the receive serial clock and 20 microseconds before the next positive going transition of the receive serial clock.

Signal Levels: Bipolar Square Wave $\pm 6v \pm 1v$.

Frequency:

For a data rate of 4800 BPS: 4800 Hz

For a data rate of 3600 BPS: 3600 Hz

For a data rate of 2400 BPS: 2400 Hz

For a data rate of 1200 BPS: 1200 Hz

Symmetry: At all data rates 50% $\pm$ 1.5% duty cycle.

Impedance: Data input/output equipment must be a resistive load of 3000 ohms or greater.

CCITT Recommendation V.24 Interface

All voltages and impedances on DC interface circuits meet the CCITT Recommendation V.24 Interface Specification. The connections between the data modem and the data input/output equipment are established by means of a 25-pin connector designated J2. This con-

necter is shown in Figure 1. A detailed diagram showing the interface circuits between the data input/output equipment and the modem is presented in Figure 2.

The nomenclature used in this document for defining certain functions for the TE-216 modem differs from that of CCITT Recommendation nomenclature. These differences are shown in Table 6.

CCITT V.24 Interface circuit descriptions follow:

Ground Circuits:

Circuit 1 — Protective ground or earth same as RS-232B Circuit AA (frame ground).

Circuit 2 — Signal ground or common return same as RS-232B Circuit AB (signal ground).

Data Signals:

Circuit 3 — Transmitted Data same as RS-232B Circuit BA (send data).

Circuit 4 — Received Data same as RS-232B Circuit BB (received data).

Control Signals:

Circuit 5 — Request to Send same as RS-232B Circuit CA (Request to Send).

Circuit 6 — Ready for Sending same as RS-232B Circuit CB (Clear to Send).

Circuit 7 — Data Set Ready same as RS-232B Circuit CC (Data Set Ready).

Circuit 9 — Data Carrier Detector same as RS-232B Circuit CF (Data Carrier Detector).

Timing Signals

Circuit 13 — External transmit data clock (to data modem) same as RS-232B Circuit DA (external transmit data clock).

Circuit 14 — Internal transmit serial clock (data modem source) same as RS-232B Circuit DB (Transmit Serial Clock).

Circuit 15 — Receive serial clock (data modem source) same as RS-232B Circuit DD (Receive Serial Clock).

MIL-STD-188B Interface

All voltages and impedances meet the requirements specified by MIL-STD-188B. The connections between the data modem and the data input/output equipment are established through a 25-pin connector designated J2. This connector is shown in Figure 1. Tables 4 and 5 define the specific functions on connector J2.

Send Data Circuit Signals on this circuit are generated by the data input/output equipment and are connected to

the TE-216 for transmission over the communication channel.

Data Levels: MARK (1) +0.5v to +20v; SPACE (0) -0.5v to -20v.

Input Impedance: 5000 ohms minimum.

Received Data Circuit The signal on this circuit is generated by the receiving modem.

Data Levels: MARK (1) +6.0v $\pm$ 1v; SPACE (0) -6.0v $\pm$ 1v.

Output Impedance: 200 ohms maximum

Transmit Serial Clock Circuit The signal on this line is from the modem and is used to provide transmit timing information to the data input/output equipment.

The data equipment shall provide a transmitted data signal with the data level present at least 20 microseconds before and 20 microseconds after the negative going transition of the Transmit Serial Clock.

Signal Levels: Bipolar Square Wave $\pm$ 6.0v $\pm$ 1v.

Frequency:

For a data rate of 4800 BPS: 4800 Hz

For a data rate of 3600 BPS: 3600 Hz

For a data rate of 2400 BPS: 2400 Hz

For a data rate of 1200 BPS: 1200 Hz

Symmetry: At all data rates: 50% $\pm$ 1.5% duty cycle.

Impedance: 200 ohms maximum.

Receive Serial Clock Circuit The signal on this line is from the modem and is used to provide receive timing information to the data input/output equipment. The data signal level on the receive data line will be present for a period between 20 microseconds after the positive going transition of the Receive Serial Clock and 20 microseconds before the next positive going transition of the Receive Serial Clock.

Signal Levels: Bipolar Square Wave $\pm$ 6.0v $\pm$ 1v.

Frequency:

For a data rate of 4800 BPS: 4800 Hz

For a data rate of 3600 BPS: 3600 Hz

For a data rate of 2400 BPS: 2400 Hz

For a data rate of 1200 BPS: 1200 Hz

Symmetry: At all data rates: 50% $\pm$ 1.5% duty cycle.

Impedance: 200 ohms maximum.

External Transmit Data Clock Circuit The signal to the TE-216 modem on this line is used to provide the modem transmitter with data rate timing from the external data input/output equipment. The data level must be present at least 20 microseconds before and 20 microseconds after the negative going transition of the External Transmit Clock.

Table 7. Data Rate Input/Output Modes.

Data Rate	Mode	Number Serial I/O Data Channels	Serial Input Channel Designation	Serial Output Channel Designation
4800	1	1	Send Data	Receive Data
2400	2	1	Send Data	Receive Data
3600	1	1	Send Data	Receive Data
2400	2	1	Send Data	Receive Data
2400	1	1	Send Data	Receive Data
1200	2	1	Send Data	Receive Data

Signal Levels: Bipolar Square Wave +0.5v to +20v, and -0.5v to -20v.

Frequency:

For a data rate of 4800 BPS: 4800 Hz $\pm$.03%

For a data rate of 3600 BPS: 3600 Hz $\pm$.03%

For a data rate of 2400 BPS: 2400 Hz $\pm$.03%

For a data rate of 1200 BPS: 1200 Hz $\pm$.03%

Symmetry: At all data rates: 50% $\pm$ 1.5% duty cycle.

Impedance: 5000 ohms minimum.

Data Rate Mode Control Interface Characteristics

The modem when equipped with the Variable Data Rate Option, provides for the selection of the operating mode (see Table 7) by DC signal levels applied to one control line. The DC control signal establishes the identical data rate mode concurrently in the Transmit and Receive functions of the modem.

Data Rate Control Signal Levels The selection of the intended data rate mode of operation requires that specified DC signal levels be maintained on the control line. The specific ON/OFF DC signal levels for the control line for selection of each of the two data rate modes are presented in Table 8. Tables 3 and 5 define the connector pin assignments on Connector J2 for the control lines.

Control Signal Levels ON: +3v minimum, +20v maximum; OFF: -3v minimum, -20v maximum.

Table 8. Control Signal Codes.

Modem	Mode	Data Rate	Data Rate Control Lines
TE-216A-4D	1	4800	ON
	2	2400	OFF
TE-216A-3D	1	3600	ON
	2	2400	OFF
TE-216A-2D	1	2400	ON
	2	1200	OFF

Control Lines Input Impedance 3000 ohms minimum.

Timing Oscillator Interface Characteristics

High Stability Timing Oscillator Output Stability: 1 part in 10^8 per day.

Frequency: 100 KHz.

Source Impedance: 200 ohms nominal.

Signal Level: Bipolar $\pm 6\text{v} \pm 1\text{v}$.

External equipment termination impedance: 3,000 ohms minimum. Timing output is by means of BNC Connector (J9) located on the rear panel.

Synchronization Squelch is always provided with this option.

External Timing Oscillator Input

Recommended Stability: 1 part in 10^8 per day or better.

Frequency: 100 KHz.

Signal Level: 1v to 10v RMS Sine wave or Square wave.

Connection is made to the modem by means of a BNC Connector (J8) located on the rear panel.

Synchronization squelch is always provided with this option.

III. Physical and Mechanical Characteristics

Size and Weight

Height: $8\frac{3}{4}$ inches, Depth: $22\frac{1}{2}$ inches (Depth including connector), and Width: $17\frac{1}{2}$ inches. Designed as drawer mount to fit in standard 19-inch racks or cabinets and mounted on slides to provide access for maintenance and test purposes. Top and bottom protective covers are provided on the drawer. Total weight is 72 pounds.

I/O Connector Locations

Mounted on the rear panel of the drawer (See Figure 1) are four 25-pin connectors, two coaxial connectors, and the AC primary power receptacle. Note: Mating connectors are provided with the modem.

25-pin Connectors The 25-pin sockets on the modem are Cinch or Cannon receptacle socket connectors, vendor part number DB-25S. The data input/output equipment should have a cable equipped with a Cinch or Cannon receptacle plug connector, vendor part number DB-25P, plus a DB-51226-1 hood (Cannon or Cinch).

Coaxial Connectors BNC type receptacles are provided on the rear panel to receive a coaxial cable equipped with a BNC type plug.

AC Primary Power Receptacle Connector This is a three-

wire midget twist lock, pin contact, blade-type connector mounted on the rear panel. A mating plug with an eight-foot power cord is provided with each modem.

Controls and Indicators

Operating Control. Power On/Off Switch.

Indicator. Power-On Indicator Lamp.

IV. Installation Requirements

Site Selection

Prior to installing the modem equipment, a site must be selected that satisfies operating and routine maintenance requirements. The equipment should be located in a clean and dry area. Environmental factors such as excessive dust, moisture, high temperature or vibrations should be minimized. Availability of primary power, adequate ground, and telephone transmission facilities is necessary for installation. When the drawer is fully withdrawn from its enclosure, it extends approximately 24 inches beyond its normally-closed position. This point should be kept in mind when selecting a location. Place the modem in the proximity of the associated data input/output equipment connected to the modem. The distance separating these equipments should be restricted to 50 feet (cable length) or less.

Cooling air is drawn into the modem directly behind the front panel and expelled at the rear panel of the modem. For efficient cooling, allow a one-inch clearance on the top and bottom and a four-inch clearance at the rear of the modem.

Grounds

Frame ground and signal ground are provided at the interface connectors. These grounds are connected together at the modem power supply. (Frame and Signal Grounds can be separated if required.) Frame ground is also connected to the green (ground) third wire of the power cord. The customer should provide a three-wire outlet to the modem location from the same AC SERVICE which serves the data input/output equipment so that the same ground bus is used for both. This requirement is necessary to prevent impulse noise potentials from causing data errors. In areas of high noise levels or RF energy, it is recommended that the frame ground be returned to a ground bus within the building by using a one-half inch wide braided cable.

AC Power Requirements

Power dissipation on the TE-216 modem is approximately 300 watts. Electric power is fed to the modem through an eight-foot detachable, three-wire power cord. The cord has a three-wire plug for connection to a customer provided single-phase, 47-63 cps, 105-125 volts or 210-250 volts AC power source.

The modem is delivered for operation from a 105-125 volt AC source unless requested otherwise. If it is desired to operate the modem from a 210-250 volt AC source, it is necessary to change the AC power source leads on the Jones Barrier strip in accordance with Figure 3. Access is gained to the barrier strip by removing the bottom cover of the modem drawer.

Environmental Service Conditions

The following conditions establish the limits of environmental parameters under actual conditions of transportation, storage, and operation.

Temperature Non-operating storage is -55°C to $+75^{\circ}\text{C}$. Operating is $+0^{\circ}\text{C}$ to $+50^{\circ}\text{C}$.

Altitude Non-operating is sea level to 50,000 feet. Operating is sea level to 10,000 feet.

Humidity Non-operating is 0 to 100 per cent relative without condensation. Operating is 0 to 95 per cent relative without condensation.

Cabling Requirements

Audio Input/Output Circuits Twisted shielded pair cable, 18-gauge stranded.

Data and Timing Circuits Conventional multiconductor 18-22 gauge cable with each conductor individually shielded can be normally used for the circuits which carry data and timing information. Under extremely

adverse conditions where noise pick-up is a problem, it may be necessary to use co-axial type cable. Total cable capacitance is not to exceed 1000 picofarads.

Control Circuits Conventional shielded cable 18-22 gauge stranded.

Frame and Signal Ground Leads Conventional cable 16-gauge minimum. In an extremely noisy environment the use of a one-half-inch-wide braided cable is recommended between the data modem and the data input/output equipment.

V. Accessory Equipment

The portable TE-890 Test Unit is available for use in checking the modem performance (See Figure 4). When tests are to be performed, the test unit cable is plugged into the connectors (J7 on the front panel or J5 on the rear panel).

The test unit contains a test pattern signal generator, a test signal comparator, error indicator, and an error count output. The test unit is used to verify the operational status of a local modem and also to verify the operational status of a data link including the modems at each end of the link. The test unit provides the additional capability of independently testing each data tone channel as an aid to isolate a malfunction.

Figure 3. AC Power Requirements.

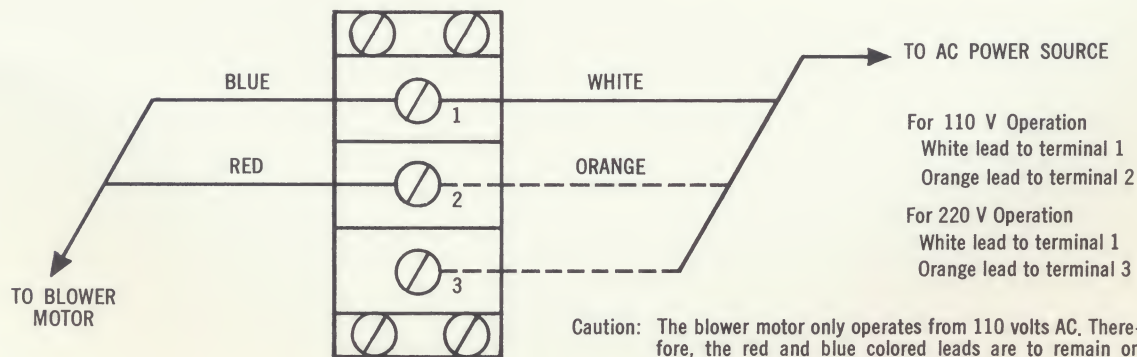


Figure 4. Portable TE-890 Test Unit Shown Attached to Handle of TE-216A-4D 4800 BPS Modem.



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